Monitoring and Documenting Green Stormwater Best Management Practices

Steve Wise -
Natural Resources Program Manager
Bill Eyring - Senior Engineer

Illinois Sustainable Technology Center
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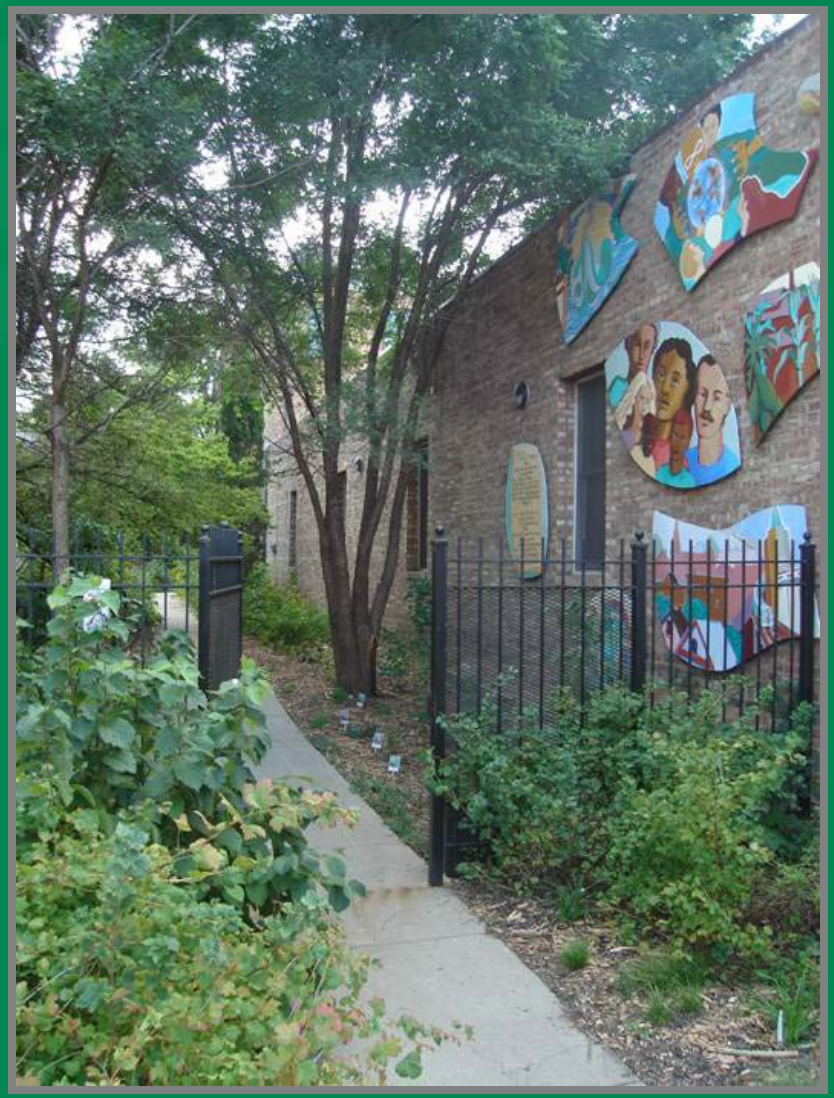
CNT

The Center for Neighborhood Technology

- 30 year old Chicago-based non-profit
- Sustainable energy, transportation, natural resource, climate strategies:
  - Research
  - Advocacy
  - Demonstration projects
  - Scaling up, replication
- Green Infrastructure agenda
  - Planning/Analysis Toolbox
  - Policy
  - Education
  - Practice



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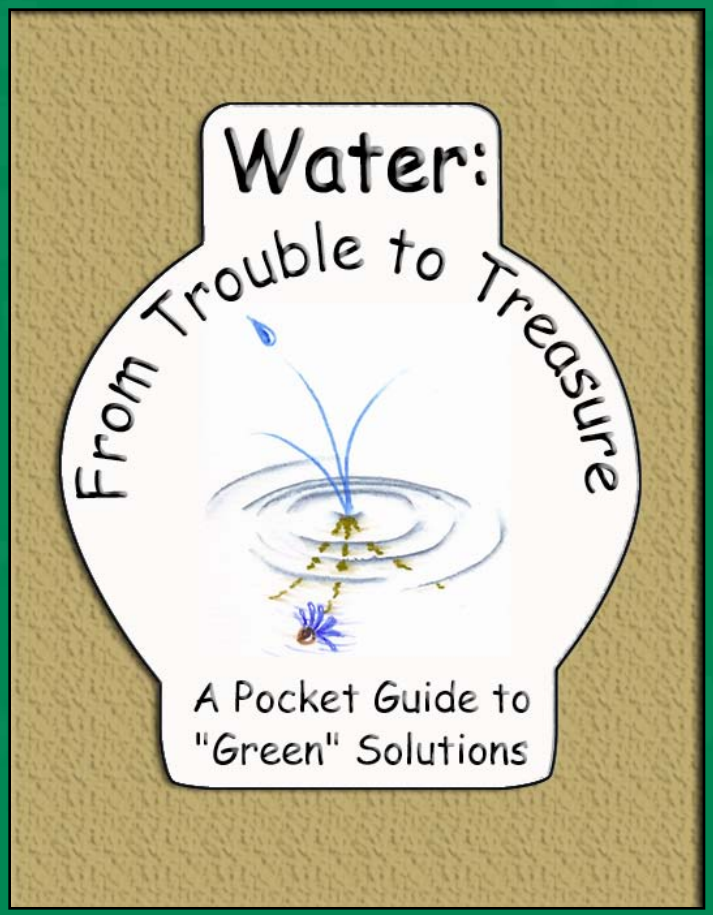
CNT Green Infrastructure Tools



Outreach

Policy Development

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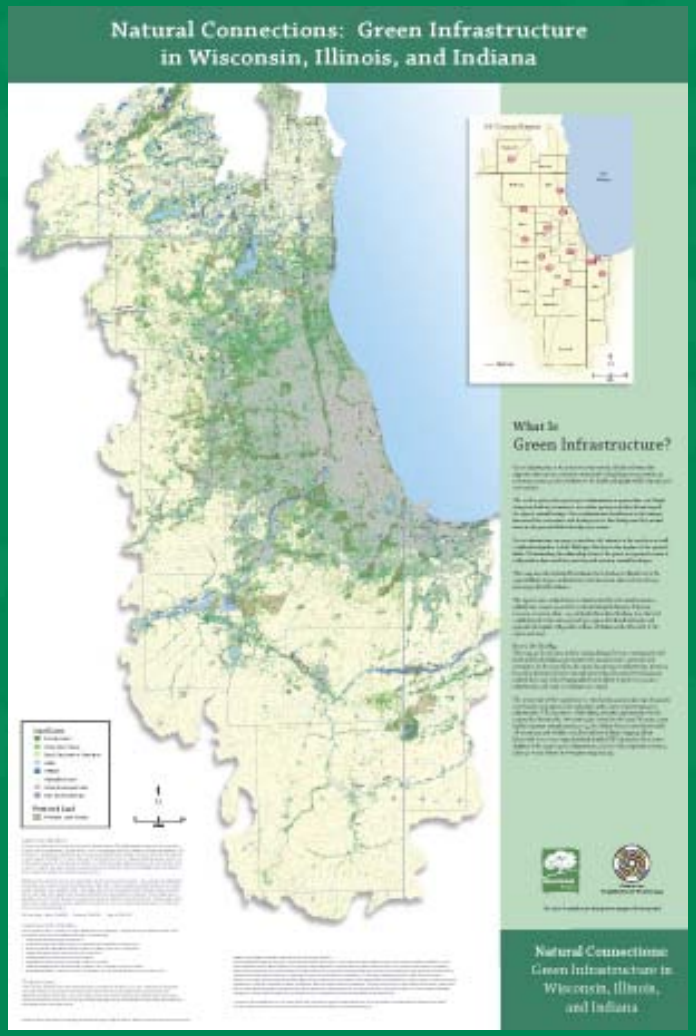
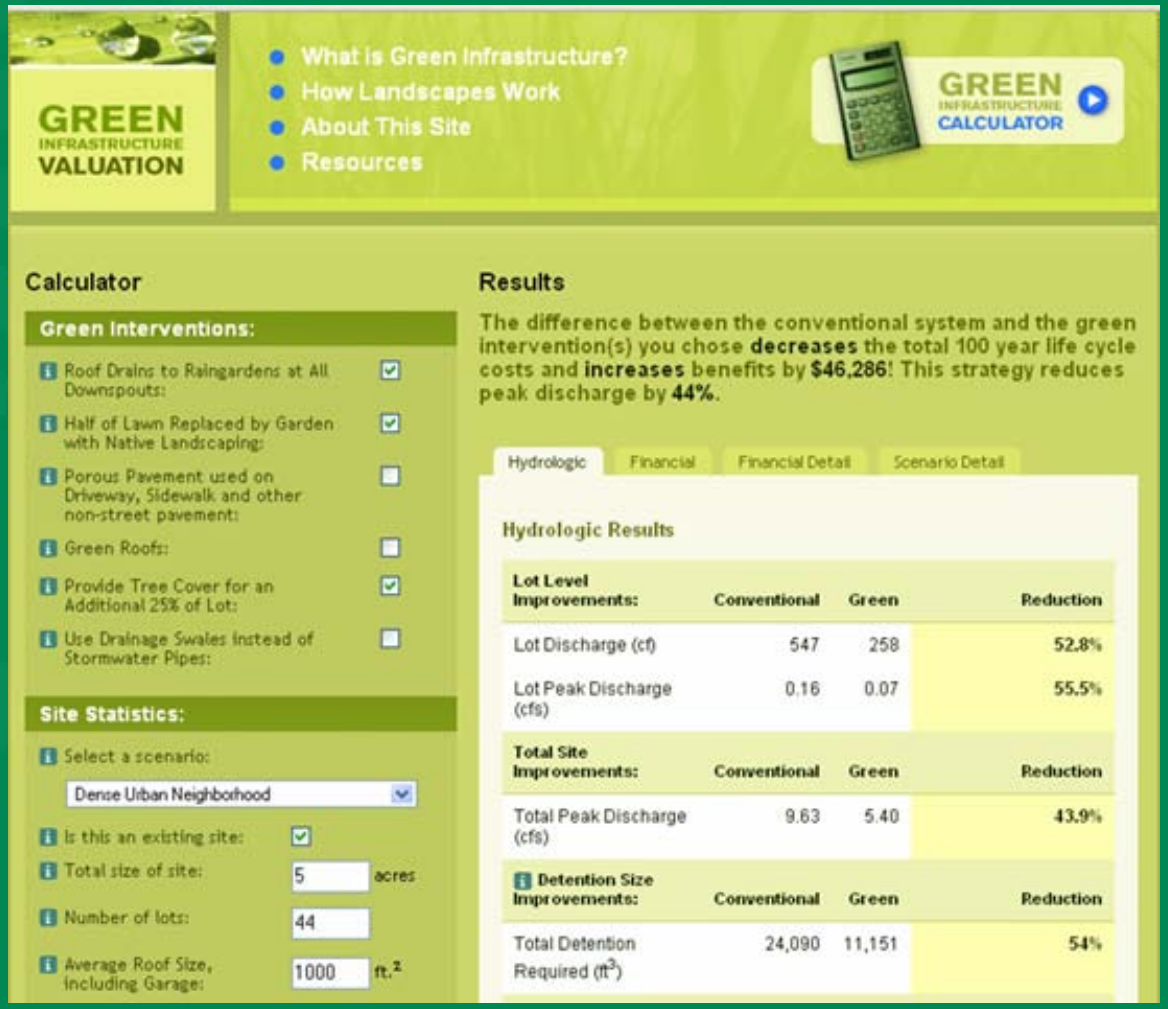
CNT Green Infrastructure Tools



greenmapping.org



greenvalues.cnt.org

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Hey and Associates

- Founded in 1976
- Business purpose was to provide an interdisciplinary approach to water resources and ecological problems.
- Combine engineering, ecology, water quality and landscape architecture.
- 35 person staff with 9 water resources engineers and 12 ecologists

Project History

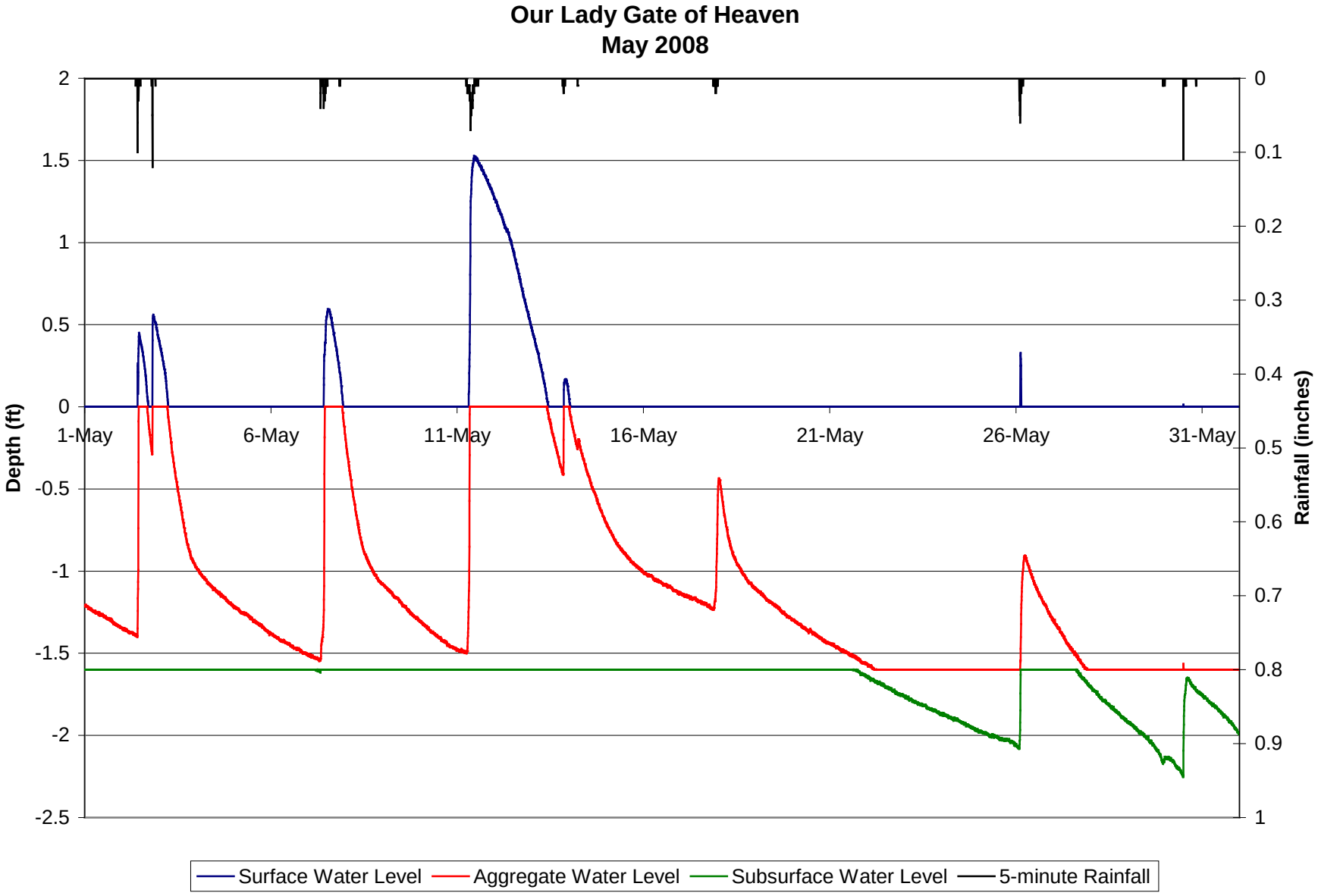
- USEPA Project – 2007-2008
  - 2 bioswales, 2 rain gardens
- IEPA Project – 2007-2008
  - 2 rain gardens, 1 vegetated swale
- ISTC Project
- Related Activities
  - Other monitoring in the region
  - Rain garden demonstrations
  - Policy analysis and advocacy
  - Illinois EPA and legislature

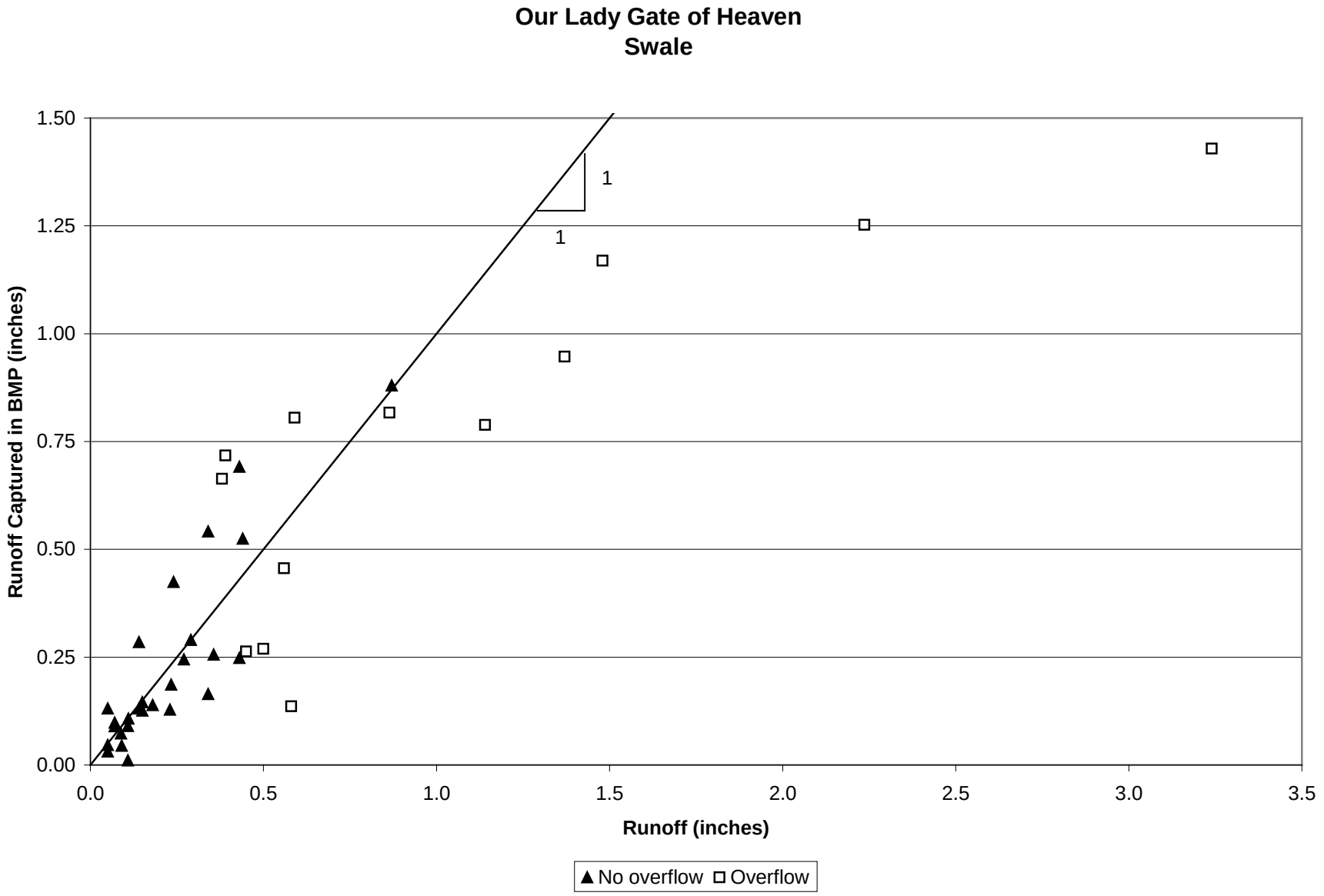
Calumet Bioswale

- Constructed in 2007 with USEPA funding
- Monitored from Oct. 2007 to the present
- Size: 10 by 66 feet
- Drains 12,433 sq.ft.
- Repair of outside drain is needed

Results in 2009 and before

- Infiltration rates of 0.2 to 0.8 inches per hour
- Infiltration rate of the swale is limited by the infiltration rate of the subsoils
- Performance satisfactory for events up to 0.5 inches
- The swale is receiving overflow from the adjacent sewer system during events over 0.5 inches





Rogers Park Pervious Concrete

- Constructed in 2008 with USEPA funding
- Monitored 2009 to present
- Two 15 by 15 ft. patches in 8,704 sq.ft. parking lot
- Infiltration Rates of 1.08-1.31 in./hr when clogged
- Surface Infiltration Capacity of 33.2-88.3 in./hr.(ave.57.87) after washing and 6.01-63.80 (ave.38.35) after winter

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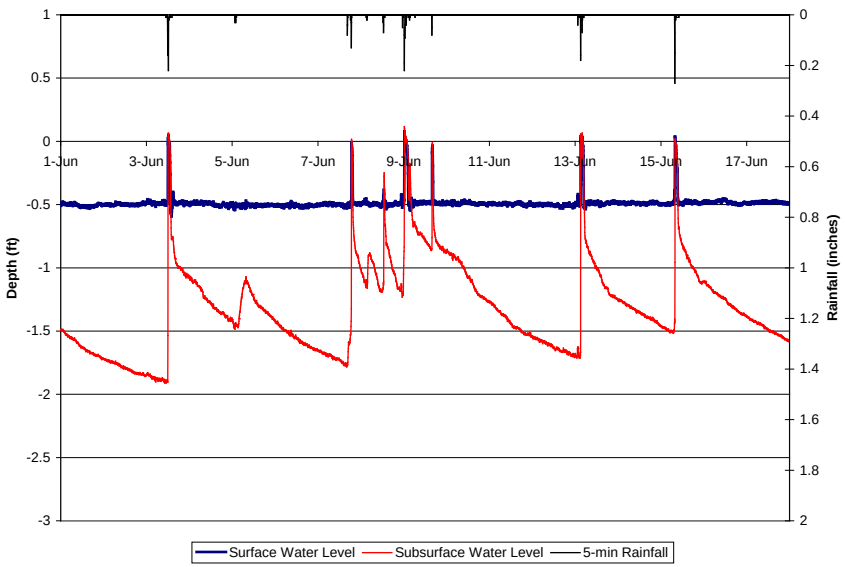
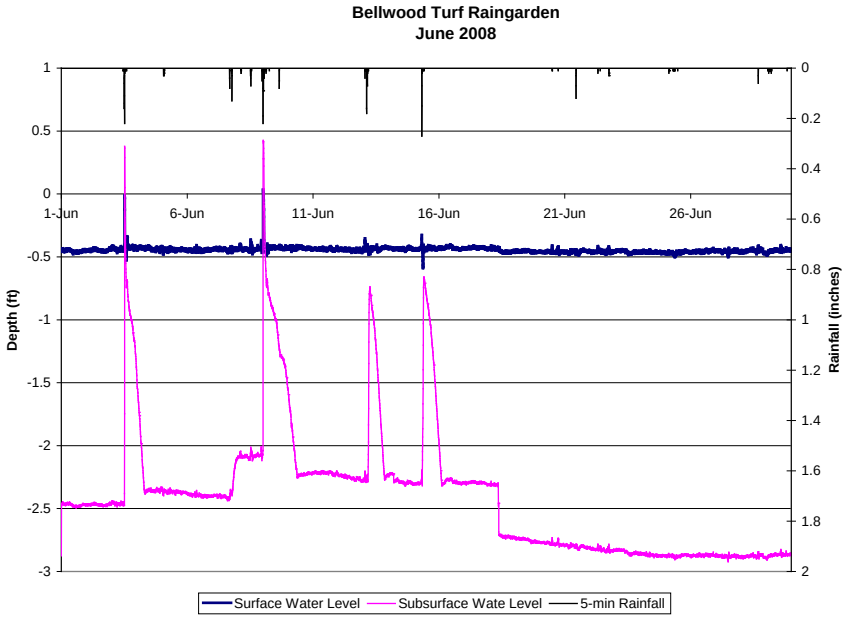
Bellwood Rain Gardens

- Constructed in 2008 with IEPA funding
- Raingardens of 220 and 230 sq.ft.
- Roof drainages of 1,340 and 1,540 sq.ft.

Results in 2008

- Data collected between May 2008 and October 2008
- One well was insufficient to represent water captured in the gardens, even though they are only 230 square feet
- The turf rain garden is performing better thus far in the project
- The 5-minute recording period may have been too long to catch the near immediate response time of above ground storage in these small gardens
- A water level recording interval was reduced to one minute in July and V-notch weirs were added





Results in 2009

- Infiltration Rates
  - Turf grass = 91.3 in/hr
  - Native = 3.3 in/hr
- Additional infiltration testing is needed
- Rain gardens leak during storm events
- Weir coefficients have been calculated for the installed weirs

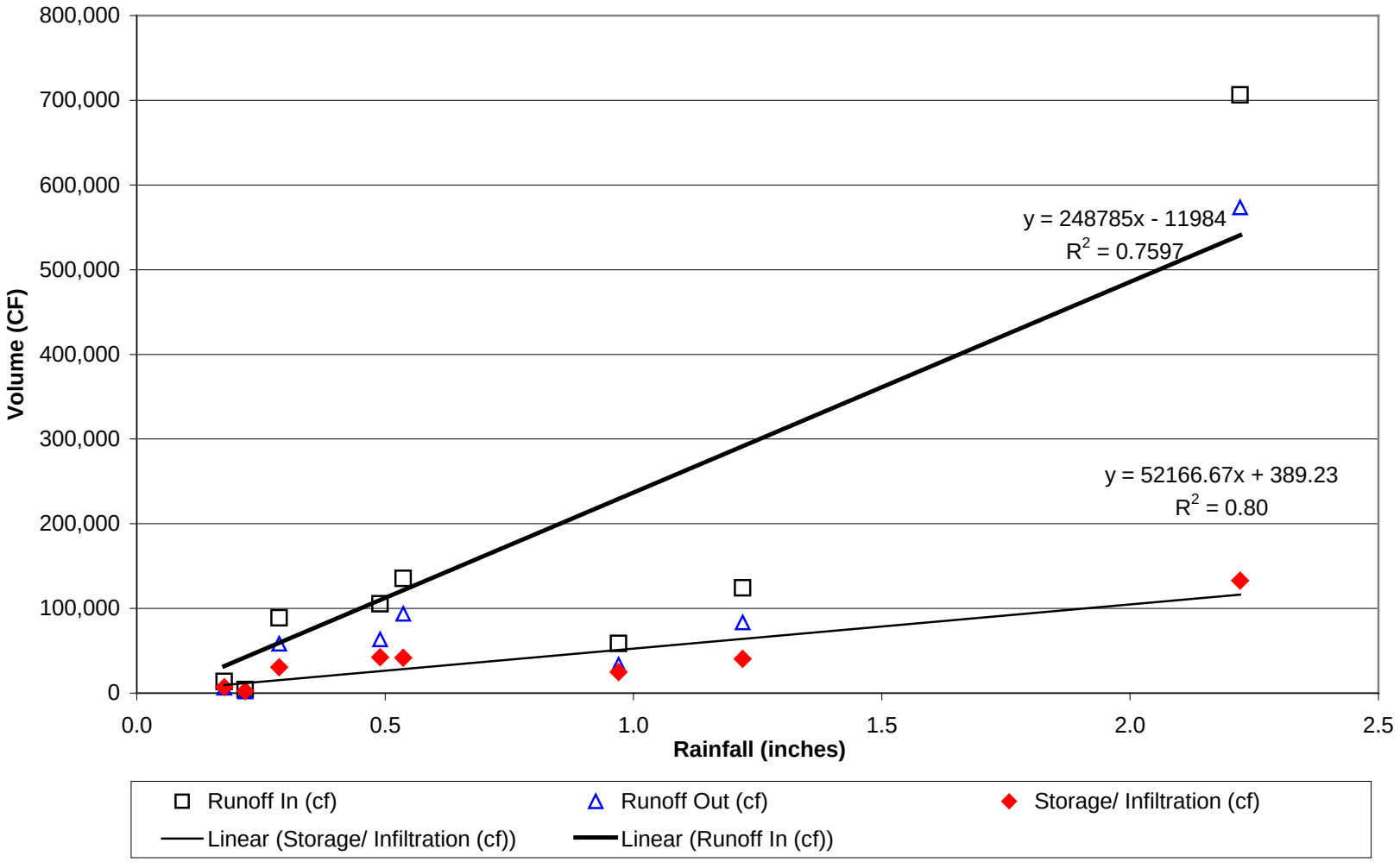
Vegetated Swales

- The Owens Road Swale
- The search for another
- The limited opportunities and likely uses

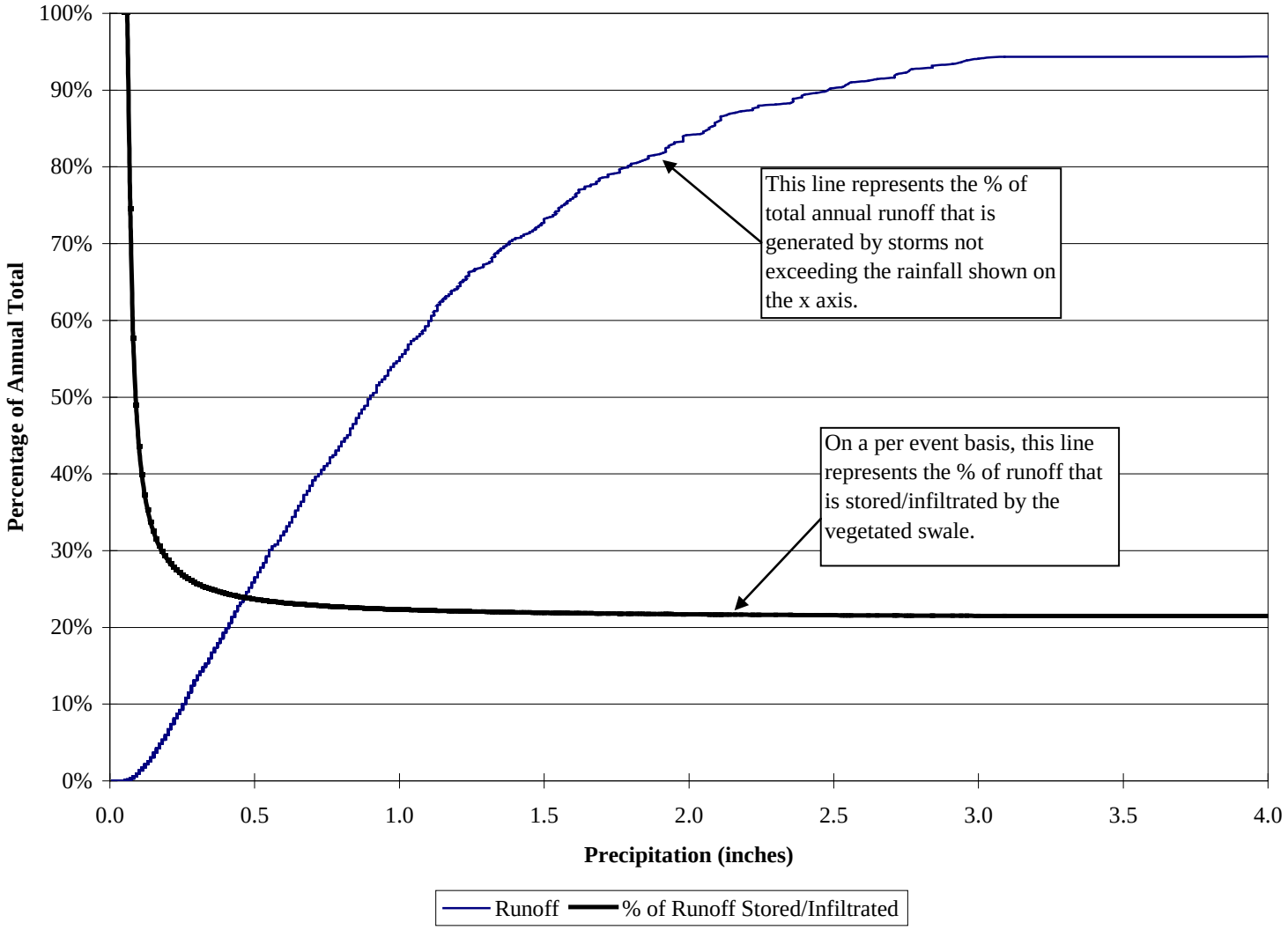
Results in 2008

- Water Quality Testing
  - Testing of the inflow and outflow indicated high water quality
  - Flow weight sampling provides the most inclusive results on the performance of the swale
- Water Quantity Testing
  - Based on 8 storms

Owens Road Vegetated Swale
Rainfall versus Runoff and Infiltration Volumes



Owens Road Vegetated Swale
Rainfall versus % of Total Annual Runoff



Benefits of a G.I. Inventory

- The City of Chicago is stalled on an inventory
- The MWRD needs to hear about their extent and performance
- Engineers and regulators are eager for information
- Costs and performance vary widely and need to be communicated

Benefits of Expansive Assessment

- Monitoring is high cost, weather dependent and limited to a few sites
- BMPs range greatly in size, complexity and cost, so many samples are better
- Inventory and assessment leads to more implementation
- A variety of audiences will be interested in the results and able to act on them

Plans for 2010

- Continue monitoring at Bellwood, Rogers Park and Calumet sites
- Inventory green infrastructure throughout 6-county Chicago Region
- Select rain gardens and porous pavements for evaluation
- Visual assessments of about 70 sites
- Infiltration capacity testing of 12 sites
- Synthetic drawdown testing of 4 sites
- Reporting to regulators and engineers

Inventory of Existing BMPs

- Email requests to 200 potential informants with request that they share with others
- Personal reminders to best sources
- 82 facilities so far with many more coming
  - 36 rain gardens
  - 8 permeable pavement
  - 8 bioswales
  - 2 green roofs
  - 4 water harvesting systems
  - 24 other

Assessing Rain Gardens

- Visual Assessments
  - Hydraulic Conditions
  - Vegetation
  - Soils
- Infiltration Rate Testing
- Synthetic Drawdown Testing

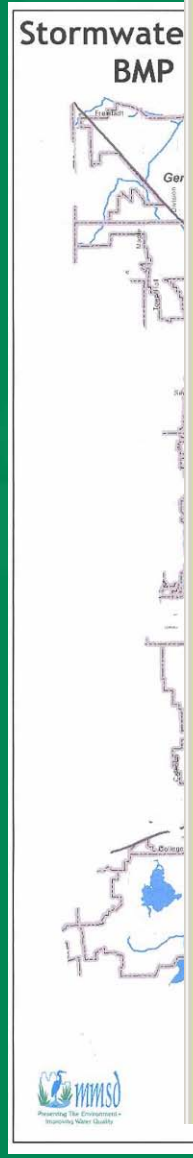
Assessing porous pavement

- Visual Assessments
  - Setting and runoff sources
  - Hydraulic Conditions
- Surface Infiltration Capacity Testing

Future Tool - Permeability Index

- Multiple Scales: Expand analysis, planning, application from site/parcel to community impact
- Performance-based targeting, assessment
- Address life-cycle cost of scenarios:
  The sustainable must be attainable
- Improve accountability:
  Only that which can be counted can be counted upon
- Identify and capture Green Infrastructure Capacity in highly urbanized landscapes (re-development)

Green Infrastructure Registry



Green BMPs

- ☐ Green Roof
- ☐ Planter Boxes

- ☑ **Bioinfiltration System** (Rain Garden)
  - Amount (ft^2): 100
  - Prepared Soil:
    - Depth (in): 18
    - Porosity (Void Ratio): 0.35
  - Underlying Aggregate:
    - Depth (in): 12
    - Porosity (Void Ratio): 0.25
- ☐ Native Vegetation
- ☐ Vegetation Filter Strips
- ☐ Swales
- ☐ Trees

- ☑ **Permeable Pavement on Parking**
  - Amount (%): 100
  - Material: Brick/Cobblestor
  - Underlying Aggregate:
    - Depth (in): 12
    - Porosity (Void Ratio): 0.25
- ☐ Permeable Pavement on Driveways
- ☐ Permeable Pavement on Sidewalks

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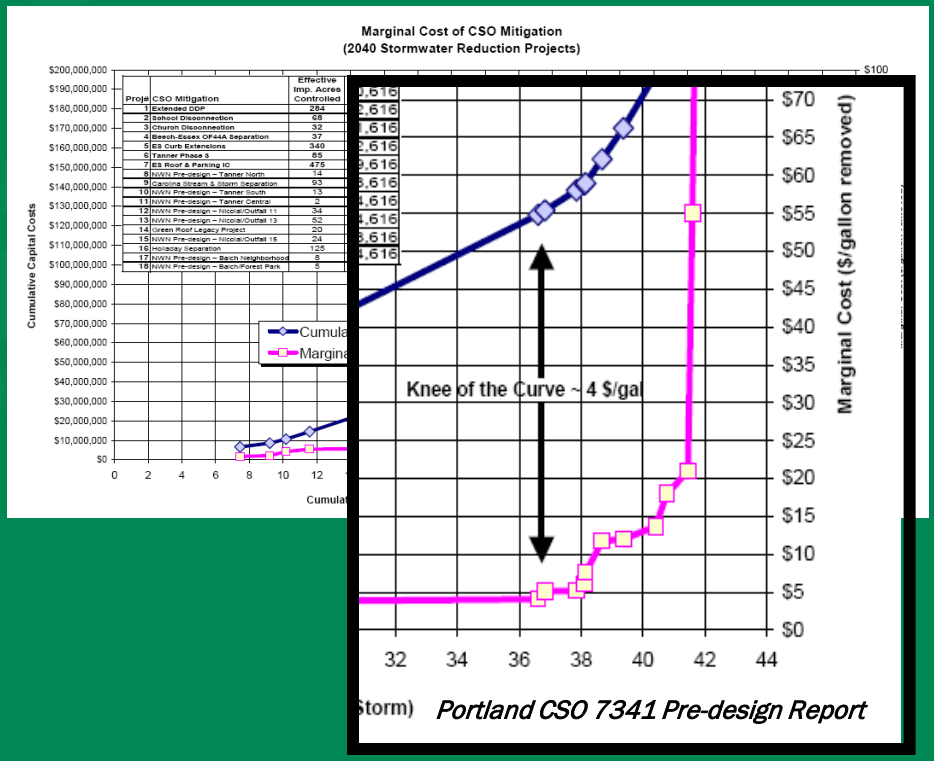
Least Cost / Sustainable Great Lakes Water Planning

- how a least-cost, demand-side management approach termed “integrated resource planning” (IRP) can assist in improving the economic efficiency of water supply, wastewater and stormwater utilities



- Advisory group convened:

CMAP, Alliance for the Great Lakes, The Joyce Foundation, the Energy Center of Wisconsin, Milwaukee Metropolitan Sewerage District (MMSD), NRDC, ECT, Inc. & Steve Brick (formally of Joyce Foundation).

- Initial Workshop in late April

IEPA Green Infrastructure Study – PA 96-0026

Costs of Green Infrastructure

	CNT	RESEARCH	CRWD	RESEARCH	CNT	CALC
BMP	$/SF	$/CF	$/SF	$/CF	$/SF	$/CF
RAIN GARDENS	$9-$32	$.04-$.11	$8.55 ave.	$.04-$.07	$7	$.25
BIOSWALES	$13-$31	$.02-$.03			$7.10	$.39
VEGETATED SWALE	$2.40	$.01				
INFILTRATION TRENCHES			$11.77 ave.	$.02-$.03		
PERMEABLE PAVEMENT	$7.10	$.01			$7.10	$.59
GREEN ROOFS					$15.75	$.58

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Answering the Global Challenge

"It is this kind of project that needs to be replicated a billion times around the world."

-- Nobel Peace Laureate Wangari Maathai

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Thank You

Bill Eyring and Steve Wise

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bille@cnt.org, swise@cnt.org